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A CONVERSATIONAL MODEL OF CAUSAL EXPLANATION

Summary

A conversational model of causal explanation is outlined, which emphasises the role of counterfactual reasoning, contrast cases and conversational constraints in causal explanation. It is used to organise existing models of causal attribution, to integrate attribution research with other models of causal reasoning, and to study explanations in ordinary language.

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In this review I present a conversational model of causal explanation, which emphasises the role of counterfactual reasoning, contrast cases, and conversational constraints in explanation. I show how this model can be applied to analysis of information in Kelley's (1967) cube and provides an organising framework for various attribution theories. I then show how it can be extended to analyse explanations given on the basis of naturalistic causal scenarios expressed in ordinary language. The conversational model of causal explanation thus provides a simple, parsimonious and unifying framework for understanding causal explanation.

A CONVERSATIONAL MODEL OF CAUSAL EXPLANATION

Hilton (1988; 1990) elaborated on the proposals of Hesslow (1983; 1984; 1988) that causal explanation proceeds by comparing a target case with a counterfactual contrast case. Every why-question thus has an implicit rather than built into it.

In counterfactual reasoning, we compare the case in which the target event happened to a counterfactual case in which the target event did not happen. The factor that is not shared by the target case and the contrast case is focused as "the" explanation, whereas the factors shared by both cases are treated as backgrounded presuppositions. For example, we are sometimes able to explain an event by contrasting it to the counterfactual case which never happened. One example would be the explanation given for the U.S. decision to drop an atomic bomb on Japan in 1945 by recourse to what might have happened if they had not done so. The question "Why did the U.S. drop the atom bomb" is thus, implicitly, "Why did the U.S. drop the atom bomb when they could have beaten Japan by conventional means?". The explanation that justified this decision is that hundreds of thousands of lives were saved because the Allies did not have to engage in the costly process of defeating Japan by taking successive Pacific islands at enormous human sacrifice. This consideration is thus not only a necessary one for the decision, but also is "sufficient in the circumstances" for it, and is thus dignified as its cause (cf. Mackie, 1974).

Clearly, another "necessary condition" for dropping the bomb is that the U.S. and Japan were at war with each other, but since this condition was true of both the target scenario and the counterfactual scenario, it has no explanatory value and is treated as part of the "causal field" of backgrounded necessary but not sufficient conditions for the event (Mackie, 1974).

Thus, to understand a causal question, we must understand the implicit contrast it presupposes (Hesslow, 1988). Consequently, the proper unit of analysis in causal explanation is the question-answer pair (Turnbull and Slugoski, 1988). The same surface causal question can be given different meanings if the implicit contrast is changed. Suppose the implicit question is "why did the U.S. drop the atom bomb on Japan (in 1945, rather than on North Korea in 1951)?". Here the answer might refer to the fact that the U.S. was not afraid of nuclear retaliation from Japan's allies in 1945, as it would have been if it had dropped an atom bomb on North Korea in 1951.

In addition, causal explanations are constrained by maxims of conversation (Hilton, 1990). Thus they should be probably true, informative, relevant and clear (Grice, 1975). As we shall see later, observance of these maxims has important implications for the study of processes of causal explanation. Immediately below, however, I address the question of how traditional models of causal attribution can be illuminated by the conversational model of causal explanation, and brought into a single unifying framework based on counterfactual reasoning. I then show how the conversational model opens up new questions in the study of causal explanation processes.

THE "MAN-THE-SCIENTIST ANALOGY OF CAUSAL ATTRIBUTION: DEVELOPMENTS AND REFORMULATIONS

Research in attribution theory has been dominated by Heider's (1958) "man-the-scientist" analogy. Heider proposed that the layperson makes causal attributions in much the same way that a scientist does, namely through use of Mill's method of difference. Heider's ideas were taken over and given their most influential formulation by Kelley (1967) in the so-called ANOVA model, and it is this formulation that will prove the foundation for much of the research described in this article.

Kelley, following Mill, defined a cause as "that condition which is present when the effect is present and which is absent when the effect is absent" (1967, p. 154). Given an event such as John laughed at the comedian, this logic implies that certain "control" conditions should be examined to determine the cause of the event. Thus if we wish to determine whether the person (i.e. John) is the cause, we should examine consensus information to determine whether other people laugh at the comedian or not. If we wish to determine whether the stimulus (i.e. the comedian) is the cause, then we should examine distinctiveness information to determine whether John laughs at other comedians or not. Finally, if we wish to determine whether the present circumstances (sometimes called occasion or time) is the cause, then we should examine consistency information to see if John laughs at this comedian on other occasions.

As Mackie (1974) notes, Mill's method of difference is a specific example of counterfactual reasoning. The target case, or set of cases, (where the effect occurs) is compared to a contrast case (where the effect does or does not occur). Paradoxically, though Kelley (1967) stated this logic of "controlled experimentation" clearly, he and others did not elaborate and test this logic in subsequent experiments on attribution processes (McArthur, 1972; 1976; Orvis, Cunningham and Kelley, 1975). For example, Kelley (1967) only made predictions for three of the eight possible cells made by crossing high and low levels of consensus, distinctiveness and consistency information.

The formalisation of how Mill's method of difference should be applied to the analysis of consensus, distinctiveness and consistency information had to await the development of the inductive logic model of causal attribution (Jaspars, Hewstone and Fincham, 1983). Jaspars et al. (1983) noted that it was impossible to conduct an analysis of variance or its formal equivalent on the information pattern provided to subjects by McArthur (1972). A little reflection will suffice to reveal that in any experiment designed to test the operation of three factors (person, stimulus, occasion) in a fully-crossed 2x2x2 design, eight cells of information are necessary. In McArthur's (1972) experiment subjects were provided with only four, namely the target event in combination with consensus, distinctiveness and consistency information. Consequently, four cells of information are missing, rendering the "experimental design" equivalent to a fractionated block design in which analysis of interactions is impossible.

Although an ANOVA-like analysis is impossible on the information given in McArthur's experiment, it is still possible to apply Mill's method of difference to the information provided. Specifically, given a target event such as <u>John laughs at the</u>

comedian, Jaspars proposed that low consensus (i.e. no-one else laughs at the comedian) indicates the target person as a cause because the effect is present when the target person is present, but not when other target persons are present. Likewise, high distinctiveness (i.e. John laughs at no other comedians) indicates the target stimulus as cause because the effect occurs when the target stimulus is present but not when other stimuli are present. Finally, low consistency (i.e. John has never laughed at the comedian before) indicates that the present occasion is the cause, because the target event occurs on this occasion but not on others.

The inductive logic model also predicts interactional attributions, through joint coding of factors. Thus the LHH (low consensus, high distinctiveness and high consistency configuration) indicates the combination of the person and the stimulus as cause. This is because the effect occurs only when the joint condition of person and the stimulus together is present (target event, high consistency) and does not occur when the joint condition of the person and stimulus together is absent (low consensus, high distinctiveness).

This last set of interactional predictions led Jaspars to an important procedural innovation. Jaspars (1983) explicitly specified all the possible response combinations created by combinations of the person, stimulus and circumstances; i.e. person, stimulus, circumstances, person x stimulus, person x circumstances, stimulus x circumstances, and person x stimulus x circumstances. McArthur (1972) on the other hand, only explicitly specified "main effect" attributions (person, stimulus, circumstances) in her response format, and asked subjects to write any interactional attributions down. The difference in response formats seems to have had a strong effect on the proclivity to produce interactional attributions. Those studies which used full response formats produced 61% (Jaspars, 1983) and 48% (Hilton and Jaspars, 1987) interactional attributions, whereas those that did not only produced 35% (McArthur, 1972) and 37% (Hewstone and Jaspars, 1983). Consequently, the earlier study by McArthur (1972) may have seriously underestimated subjects' ability to produce appropriate interactional attributions.

Following the inductive logic model, the predictions detailed in the left-hand column of Table 1 can be derived.

INSERT TABLE 1 ABOUT HERE

Further details of the inductive logic model are detailed in Hewstone and Jaspars (1987), Jaspars (1988) and Jaspars, Hewstone and Fincham (1983). Studies designed to test the inductive logic model provided an impressive degree of confirmation for the model (Hilton and Jaspars, 1987; Jaspars, 1983). Moreover, re-analyses of the data of Hewstone and Jaspars (1983) and McArthur (1972) also provided strong support for the inductive logic model (Hewstone and Jaspars, 1987).

As Hilton, Smith and Alicke (1988) noted, the inductive logic model proposes that low consensus information leads to person attribution and high distinctiveness information leads to stimulus attribution, whereas most other models of causal attribution propose that high consensus information leads to stimulus attribution and low distinctiveness information leads to person attribution (Alicke and Insko, 1984; Anderson, 1978; Bassili and Regan, 1977; DiVitto and McArthur, 1978; Garland, Hardy and Stephenson, 1975; Hansen, 1980; Hortacsu, 1987; Kassin, 1979; Major, 1980; McArthur, 1972; 1976; Orvis et al., 1975). Both the inductive logic models and the other models, such as that or Orvis et al. (1975), posit that high consistency leads to circumstance attributions (see Table 2).

INSERT TABLE 2 ABOUT HERE

Although the consensus-stimulus and distinctiveness-stimulus links proposed by the latter models deviate from the counterfactual logic implicit in Kelley's (1967) definition of causality, they clearly have won widespread acceptance. Intuitively, there does seem to be sense in the claim that consensus information is somehow "about" the stimulus and distinctiveness information is intuitively "about" the person (Higgins and Bargh, 1987). Below, we shall review a proposal which integrates the position of the inductive logic model (Jaspars et al., 1983) with that of Orvis et al.'s (1975) template-matching model (Hilton, 1989b). Specifically, it is argued that causal explanation must be distinguished from dispositional attribution. When this is done it is possible to see that causal explanation is achieved through the application of Mill's method of difference (i.e. counterfactual reasoning) and dispositional attribution through application of Mill's method of agreement.

<u>Causal explanation and dispositional attribution</u>

Causal explanation and dispositional attribution are not the same thing. In causal explanation we explain why a particular event happened, whereas in dispositional attribution we attribute a general pattern of behaviour to an underlying characteristic of one or more of the entities involved.

Certain covariation configurations identify the same entity as the cause of the event to be explained, and as having an underlying disposition to produce the kind of behaviour in question. These are the low consensus, low distinctiveness and high consistency (LLH) and high consensus, high distinctiveness and high consistency (HHH) configurations. For example, in the LLH configuration below, we would say that Paul is a generally helpful person (dispositional attribution), and that this is the cause of his helping Linda (causal explanation).

Paul helps Linda

Hardly anyone else who knows her helps Linda
Paul helps almost everyone else he knows
In the past, Paul has almost always helped Linda

There has been perhaps a tendency to assume that covariation configurations always imply dispositional attributions to those entities that they identify as causes. This tendency would have been exacerbated by the fact that Kelley (1967) only made predictions for the LLH and HHH cells, and that McArthur (1972) focused on "main effect" attributions to the person, stimulus or circumstances at the expense of interactional attributions.

An interesting contrast emerges when we compare the causal inferences that can be made from the high consensus, low distinctiveness and low consistency (HLL) configuration below:

Paul helps Linda

Almost everyone else who knows her helps Linda
Paul helps almost everyone else he knows
In the past, Paul has hardly ever helped Linda

In properly designed attribution experiments with full response formats (see above), the cause is predominantly attributed to the circumstances (Hilton and Jaspars, 1987; Jaspars, 1983), the present occasion (Hilton and Slugoski, 1986) or time (Försterling, 1989), depending on the specific phrasing used. However, although Paul does not usually help Linda, he would still seem to be a generally helpful person because he helps most people. Although we would attribute the cause of his helping Linda here to something about the specific occasion (causal explanation), we would probably still make the inference that he is a helpful person in general (dispositional attribution).

<u>The methods of difference and agreement</u>

Hilton (1989b) presented a functional model of social inference which argues that <u>causal explanations</u> are produced by Mill's method of difference, whereas <u>dispositional attributions</u> are produced by Mill's method of agreement. The model is <u>functional</u> because different methods of induction are depending on the goal of the inference process.

Mill's method of difference is used to explain why a <u>particular</u> event occurred. It involves comparing a target event to a comparison event (or, as instantiated by the inductive logic model of Jaspars et al., 1983, a set of events). Consequently, the "control condition" for assessing the causal role of the person would be to determine whether the effect occurs in the presence of other persons or not (consensus information). If the target event occurs when the target person is present but does not occur when the target person is absent (low distinctiveness), then the case in which the target event occurs <u>differs</u> from the others in which it does not occur in that Paul is present whereas he is absent in the other cases. Consequently, something about the target person is designated as the cause that "makes the difference" (see Table 3).

INSERT TABLE 3 ABOUT HERE

However, when we learn that Paul helps most people (low distinctiveness), we make the dispositional attribution that <u>Paul is a helpful guy</u>. This dispositional attribution is accomplished by a process analogous to Mill's (1872/1973) method of agreement. Here all the cases in which the effect occurs <u>agree</u> in having Paul present (see Table 4). Consequently, high consensus will

INSERT TABLE 4 ABOUT HERE

predict dispositional attribution to the stimulus because all examples agree in having the target stimulus present when the effect occurs, and low distinctiveness will lead to stimulus dispositional attributions because all examples agree in having the target person present when the effect occurs. High consistency should also lead to dispositional attribution to the person and the stimulus because all cases agree in having the person and the stimulus present when the effect occurs. However, the the amount of dispositional attribution under high consistency may be expected to be smaller than under high consensus and low consistency because a) the behavior is attributed to two sources (the person and the stimulus) rather than one (the person or the stimulus), and b) the generalization of the target event over other times alone does not imply the same amount of generalization as the consensus and distinctiveness dimensions, which imply generalization of the effect over other persons and times, and other stimuli and times, respectively.

When the subject is required to explain <u>why</u> the target event happened in experiments using the paradigm of McArthur (1972), the results are consistent with the application of the method of difference, with the exception of the high consensus, low distinctiveness, high consistency (HLH) cell (Hewstone and Jaspars, 1987; Hilton and Jaspars, 1987; Jaspars, 1983). None of these experiments asked subjects to make dispositional attributions, however. Hilton (1989b) did not ask subjects to produce causal explanations as in the other studies, but to make dispositional attributions from covariation information, and found the judgments predicted by application of the method of agreement specified above. High consensus led to stimulus dispositional attributions and low distinctiveness to person dispositional attributions, and high consistency to moderate dispositional attributions to the person and the stimulus. In contrast to the very strong effects obtained in support of the operation of the method of agreement, there was little support for the operation of the application of the method of difference. Thus there no effect of consensus on person attributions and only a relatively small effect of high distinctiveness on stimulus attributions.

The functional model of social inference thus appears to fit the data well. It also helps explain some previous inconsistencies. For example, Iacobucci and McGill (in press) re-analysed the data of several attribution experiments (Hewstone and Jaspars, 1987; Hilton and Jaspars, 1987; Jaspars, 1983; McArthur, 1972) using log-linear techniques. They found that although the inductive logic model of Jaspars et al. (1983) fit these data better than the template-matching model of Orvis et al. (1975), "residual variance" still needed to be accounted for by the consensus-stimulus and distinctiveness-person inferential links posited by the template matching model. This pattern would be predicted if subjects tended to treat the causal explanation task as a dispositional attribution task. Finally, the functional model predicts the information acquisition results obtained by Hilton, Smith and Alicke (1988), who found in some conditions that subjects were more likely to prefer consensus information when asked to <u>explain</u> a sporting performance than when they were asked to <u>evaluate</u> how good the person performing the event was, i.e. to make a dispositional attribution of ability to him.

The functional model of social inference thus clarifies aspects of the attribution process. A full treatment of this model is not possible here (but see Hilton and Smith, 1990). For present purposes, its main advantage is to show that counterfactual reasoning, in the form of Mill's method of difference, is used to provide causal explanations of an event. Below, we address the question of how real-world knowledge is combined with explicitly given information in the causal attribution process.

WORLD KNOWLEDGE AND THE PROCESS OF CAUSAL ATTRIBUTION

The abnormal conditions focus model

Hilton and Slugoski (1986) noted that people bring real-world expectancies with them to the attribution task. They based their analysis on the criticisms made of the Millian definition of causality given by the legal theorists, Hart and Honoré (1985). Specifically, Hart and Honoré (1985) argued that the method of difference could reveal an innumerable number of necessary conditions but for which a target event would not have happened. For example, if a train crashes, we may be able to reason counterfactually that the train would not have crashed if the train had not been travelling so fast, or if it had not been so heavily laden, or if there had not been a bent rail in the track, and so on. Thus the crash could be attributed to any one of a plethora of necessary conditions. However, in normal conversation, we typically tend to mention only one factor as "the" cause in causal explanation. This raises the problem of how to select causes from conditions. Hart and Honoré (1985) proposed that we normally compare the target event to the normal case to see what is abnormal about the target event. Thus, if the train normally travels at that speed and laden at that weight without crashing, then the bent rail is identified as the abnormal condition as that "makes the difference" to the train crashing or not crashing. It is thus dignified as "the" cause whereas the speed and weight of the train are relegated to the status of mere conditions which serve as background information (cf. Mackie's (1974) notion of a "causal field").

As will be shown later, the abnormal conditions focus model can be applied to a wide range of causal explanation tasks. However, Hilton and Slugoski (1986) began by applying it to the analysis of causal attribution in the McArthur (1972) paradigm. Specifically, they proposed that low consensus throws the person into focus as abnormal, high distinctiveness throws the stimulus into person as abnormal, and low consistency throws the present occasion into focus as abnormal. In their first experiment they verified these predictions by showing that subjects judged these items to be informative about the predicted targets.

Although all the details cannot be given here, Hilton and Slugoski (1986) then applied their model to the analysis of the problematic high consensus, low distinctiveness and high consistency (HLH) configuration discussed above. According to the inductive logic model of Jaspars et al. (1983), no attribution should be possible here because the occurrence of the target event generalises over other persons, stimuli and times. However, experimental results show that subjects reliably attribute the target event to either the person, the stimulus or a combination of the person and the stimulus in this condition (see Table 2). This result seems intuitively quite reasonable if we consider the configuration below:

Ralph trips up over Linda dancing

Almost everyone else trips up over Linda dancing
Linda trips up over almost everyone else dancing
In the past, Ralph has almost always tripped up over Linda

dancing

The logical conclusion would seem to be that Ralph is a clod and Linda is a clod (cf. McArthur (1972). Indeed, Hilton and Slugoski (1986) found that subjects attribute this event to multiple sufficient causes, i.e. "Something special about Ralph and Linda (even when they are not together)". In effect, Ralph and Linda are being identified as abnormal (i.e. clumsier than the average dancer). Consistent with this reasoning, Hilton and Slugoski (1986, Expt 1) showed that subjects perceived high consensus to be informative about the stimulus and low distinctiveness to be informative about the person.

However, the perceived normality of the target event appears to affect the attribition process (cf. Hart and Honoré, 1985). If the target event to be explained is highly normal (e.g. buying something in a supermarket), then the conclusions suggested by the same HLH configuration appear to be quite different:

> Sally buys something on her visit to the supermarket
>
> Almost everyone else buys something on their visit to this supermarket
> Sally buys something on her visit to almost every other supermarket
> In the past Sally has almost always bought something on her visit to this supermarket

Here, subjects attribute the event to the null option "Nothing special about Sally, the supermarket, the present occasion or any combination of the three" (Hilton and Slugoski, 1986), as predicted by the inductive logic model of Jaspars et al. (1983). Neither the person nor the stimulus are identified as the cause in this condition, since neither is identified by the covariation information as an abnormal condition. Consistent with this, neither low distinctiveness or high consensus were judged to be informative about the person or the stimulus when the target event was normal (Hilton and Slugoski, Expt. 1).

Norms and the missing dimensions of covariation information

Most experiments on attribution processes (Hewstone and Jaspars, 1983; Hilton and Jaspars, 1987; Jaspars, 1983; McArthur, 1972; 1976; Orvis et al., 1975) only presented subjects with information from four of the eight cells required to test for the causal effect of the person, stimulus and occasion using an analysis of variance or its formal equivalent. The one early exception was the experiment of Pruitt and Insko (1980), which presented subjects with a fifth dimension, namely comparison-object consensus information about the behaviour of other persons to other stimuli, e.g. about what other people do on visits to other restaurants.

Hilton (1988; 1990) elaborated the theoretical position of Hilton and Slugoski (1986) and proposed that subjects' real-world knowledge served the function of filling out the "missing dimensions" of Kelley's (1967) cube in experiments using the paradigm of McArthur (1972). This can most easily be seen by considering Figure 1, where the above target events are

INSERT FIGURE 1 ABOUT HERE

represented in 2x2 matrices. The consistency dimension has been omitted for reasons of clarity of exposition. The occurrence of an event in a given cell is signified by a "1", and its non-occurrence by a "0", and its occasional occurrence by "1/2". In both matrices, a "1" is used to signify the occurrence of the target event when the target person and stimulus are both present (the target event itself), when the target person is present with other stimuli (low distinctiveness), and when other persons are present with the target stimulus (high consensus). The difference between the two matrices comes in how the bottom right-hand cell is filled.

Thus, subjects appear to have knowledge of what normally happens when people go dancing or shopping in supermarkets. These may be expressed as norms, i.e. generalizations of the form Some people trip up over other people dancing sometimes or Most people buy things on most visits to most supermarkets. These norms may perhaps be thought of as being the lay equivalent of "covering laws" (cf. Hempel, 1965). This implicit world knowledge is then used to fill in information in the "missing cell" about what other persons do with other stimuli. Thus we would fill the missing cell with a "1" in the case of the supermarket example because normally most people buy something on their visit to most supermarkets, whereas we would only fill the missing cell with a "1/2" in the dancing example to indicate that normally some people trip up over some people dancing.

If we then perform informal equivalents of the analysis of variance on the two matrices, we obtain results that correspond to the responses that subjects give in these experiments. Thus, in the supermarket example, we obtain no effects at all (corresponding to the null option) and in the dancing example we obtain two main effects (corresponding to two sufficient causes).

Thus subjects appear to supplant the experimenter-provided information with their own world-knowledge to "complete the design" of the Kelley cube. When they have done this, they produce responses that would be predicted by a normative analysis of variance. This result stands against the widely held view that subjects "underuse" base-rate unformation (e.g. Nisbett and Ross, 1980). Rather, in this case, it seems to have been the experimenters who have generally overlooked the importance of base rate information by omitting to supply information in the form of norms to subjects. Paradoxically, it is the subjects who made good this lack by supplying this information from their own world knowledge.

It would seem that subjects are considerably more rational in using covariation information to make causal inferences than has been previously supposed. This supposition is confirmed by recent research in which subjects have been explicitly given information in all eight cells of Kelley's (1967) cube. When this is done, subjects produce inferences that correspond very closely to those that would be predicted by a normative analysis of variance (Cheng and Novick, 1990; Försterling, 1989; 1990). Comparable results were obtained by Pruitt and Insko (1980), who explicitly supplied a fifth dimension of comparison-object consensus information to their subjects. One striking feature of all these experiments is the extent to which they support the hypothesis that the method of difference is used to produce causal explanations. Thus consensus information affects person explanations, distinctiveness information affects stimulus explanations and consistency information affects circumstance/ occasion/time explanations. Particularly noteworthy is the finding that consensus information, far from being underused (McArthur, 1972; 1976; Nisbett and Borgida, 1975), has a consistently strong and predictable effect on person explanations.

One consequence of these findings would be to conclude that Kelley's (1967) ANOVA analogy actually describes subjects' causal inference processes very well. The failure to recognize this earlier is due to four main reasons. First, early theorists (McArthur, 1972; Orvis et al. 1975) did not take Kelley's (1967) suggestions to their logical conclusion. They therefore did not recognize that models (e.g. the template-matching model) that proposed consensus-stimulus and distinctiveness-person inferential links deviated from the canons of Mill's method of difference. Second, by using response formats that were incomplete and ambiguous, their experimental procedures appear to have biased the results obtained (cf. Cheng and Novick, 1990; Försterling, 1989; Hewstone and Jaspars, 1987; Hilton and Jaspars, 1987; Hilton and Knibbs, 1988). And third, by either omitting complete information from the cube, or overlooking the role of subjects' presuppositions in "filling out" missing cells, theorists underestimated subjects' ability to reason according to the canons of an intuitive analysis of variance. In fact, subjects do indeed use consensus and base-rate information in the form of norms appropriately and normatively.

<u>Counterfactual reasoning as a model of causal explanation</u>

As noted above, the conversational model causal explanation proposes that every why-question thus has an implicit <u>rather than</u> built into it, and that in order to understand a request for a causal explanation for an event, one must understand the implicit contrast drawn in the <u>why</u> question. Using this simple logic, one is able to see that the variegated attribution theories appear to share the same counterfactual logic, but to address questions which presuppose different contrasts (See Table 5; also Lipe, in press, for a similar proposal).

INSERT TABLE 5 ABOUT HERE

Thus the inductive logic model of Jaspars et al. (1983), which instantiates Kelley's (1967 p.194) definition of a cause as "that condition which is present when the effect is present and which is absent when the effect is absent" addresses the question "Why did this event occur rather than not occur?" (Why <u>x</u> rather than <u>not</u> <u>x</u>?). The abnormal conditions focus model of Hilton and

Slugoski (1986) addresses the question "Why did this event occur rather than the normal case?" (Why x rather than the default value for x?). Jones and Davis's (1965) theory of correspondent inference addresses the question "Why did the actor make this choice rather than that choice?" (Why x rather than y?). Fincham and Jaspars' (1980) entailment model of the attribution of responsibility addresses the question "Why did the actor do what he did rather than what he should have done?" (Why x rather than the moral or legal ideal?". Schank and Abelson's (1977; see also Carbonell, 1981; Wilensky, 1981; 1983) model answers questions like "Why did this plan fail rather than succeed?" (Why x rather than the projected aim) and "Why did the actor value this goal rather than that goal?" (Why x rather than y?).

Counterfactual reasoning and ordinary language

Although considerable progress has been made in modelling causal inference in specific and artificial experimental paradigms, such as that of McArthur (1972), the question still arises as to what extent these inference processes occur in other, more natural settings.

Thus, consistent with the abnormal conditions focus model (Hilton and Slugoski, 1986), unanticipated events appear to attract attention and to initiate attributional processing (Weiner, 1985). Events may be unanticipated because they are unusual (Hastie, 1984), or represent failure (Bohner, Bless, Schwarz and Strack, 1988), or are cognitively imbalanced in Heider's (1958) sense (Brown and van Kleeck, 1989).

There is also considerable evidence that people's representations of stories are best represented by an adaptation of Mackie's (1974) counterfactual test. If, by the counterfactual test, one event is deemed necessary in the circumstances for another to occur, then a link is established between the two. The network of interconnections built up by this test (Trabasso and Sperry, 1985; Trabasso, Sperry and van den Broek, 1985; van den Broek and Trabasso, 1986) predicts story event importance and recall better than formalisms derived from Schank and Abelson's (1977) model of text comprehension (Graesser et al., 1980; Graesser et al., 1981). Thus richly connected events are more likely to judged as important and be recalled than poorly connected events.

While people's representations of story-lines may be constituted of complex networks of interlocking conditions the problem of causal selection once again presents itself. How do we decide which member of a complex set of conditions to mention as "the" cause? Mill (1872/1973) himself noticed that people often omitted necessary conditions from causal explanations, instead focusing on the one that "completes the tale", and regarded this as "capricious" (System of Logic, Book III, Chapter v, Section iii). In fact, selection of causes from conditions in ordinary language seems to be quite orderly, and governed by general rules of discourse (Grice, 1975; Hilton, 1990; Hilton and Slugoski, 1986).

Generally speaking, causation tends be attributed to the factor that "could have been otherwise", i.e. that factor for which it is possible to imagine a counterfactual alternative. Abnormal conditions are easily mutable whereas normal conditions are not, and thus get focussed as causes (cf. Kahneman and Miller, 1986). This can be seen from research on people's perceptions of accidents. Accidents are typically caused by unfortunate combinations of factors. However, when asked retrospectively to "undo" a factor that led to an event, people spontaneously focus on abnormal rather than normal conditions (Kahneman and Miller, 1986; Kahneman and Tversky, 1982). People are more likely to say "If only he had gone home by his normal route" (thus undoing the fact that the victim went home by an abnormal route) than "If only he had gone home by a different route" (thus undoing the fact that the victim went home by his normal route). Consistent with the view that abnormal conditions become focused as causes, Wells and Gavanski (1989) report further evidence that those conditions that people are most likely to "undo" are those that are most likely to be judged as causes.

In a provocative study, Brown and Fish (1983) suggest that people vary more in their disposition to perform actions than in their disposition be acted upon, whereas the reverse holds true for emotions. For example, people seem to vary more in their disposition or ability to help than to be helped, whereas they vary more in their ability to elicit liking than to like (but see Au, 1986; Hoffman and Tchir, in press, for exceptions). Consistent with this, the trait adjectives derived from action verbs tend to describe a characteristic of the person performing the action (helpful, charming, etc.) whereas trait adjectives derived from state verbs tend to describe a characteristic of the person eliciting the state or emotion (likeable, hateful, etc.). In the sample of verbs studied by Brown and Fish (1983), this rule is observed in over 90% of cases. This tendency suggests that language affords us trait adjectives that are most likely to help describe the abnormal characteristic wherein a person differs from most other people, and which makes a difference to the occurrence of the event in question. The vocabulary of language itself thus tends to focus on abnormal conditions.

In default of explicit focus, implicit focus appears to be on abnormal conditions. However, explicit focus can override this. For example, when asked to explain normal states, Gavanski and Wells (1990) show that people focus on normal conditions. Although ordinary people spontaneously focus on the unusual, the unwanted and the imbalanced (see above), as Hart and Honoré (1985) point out, scientists tend to ask why things happen the way they normally do, and to explain them in terms of stable underlying characteristics.

Sometimes causal explanation will be influenced by subtle linguistic focus cues (Moxey and Sanford, 1987). For example, the quantifiers "A few" and "Few" denote the same proportion, but focus on different aspects of the set that they partition. Thus "A few" focuses attention on the minority who did perform the behaviour in question, whereas "Few" focuses attention on the majority who did not perform the behaviour in question. Consequently sentences such as "A few of the M.P.'s went to the party because..." should be completed by reasons for going (e.g. "they were still in town"), whereas sentences such as "Few of the M.P.'s went to the party" should be completed by reasons for not going (e.g. "it was boring"). Moxey and Sanford (1987) obtained data consistent with these predictions, and extended them to frequency quantifiers. Thus events quantified with "occasionally" were completed with reasons for doing the action, whereas events quantified with "seldom" were quantified with reasons for not doing the action.

Finally, various "biases" may be attributable to the implicit focus of causal questions, which can be overidden by specifying question focus explicitly. Thus McGill (1989) presents evidence that actor-observer differences in causal explanation may be attributable to implicit question focus. Normally, observers asked question such as " Why did your roommate choose chemistry?" tend to attribute others' actions to the actor, whereas actors asked questions such as "Why did you choose chemistry?" tend to attribute their actions to stimuli. However, when the actor or object is explicitly focused by focus adjuncts such as "in particular" (Quirk, Svartvik, Greenbaum and Leech, 1972), as in questions such as "Why did you <u>in particular</u> choose chemistry?", the bias is greatly attenuated. McGill (1989) presents and tests a similar rationale for explaining the tendency to explain success in terms of personal factors and failure in terms of external factors.

In sum, causal explanation seems to proceed through a process of counterfactual reasoning. Counterfactual reasoning appears to underly causal reasoning in comprehension of naturalistic stories and scenarios as well as in Kelley's (1967) ANOVA analogy. In ordinary language we appear to have natural tendencies to focus on the abnormal and to explain it by comparing it to the normal. However, this tendency, like actor-observer differences in causal explanation, can be reversed by use of linguistic focus devices. Causal selection thus appears to be determined by linguistic focus rules, which may either be implicit (e.g. determined by knowledge about what is normal and may be presupposed and what is abnormal and should be focused), or explicit (e.g. determined by explicit linguistic focus devices).

CONVERSATIONAL CONSTRAINTS ON CAUSAL EXPLANATION

Although the research reported above provides strong support for the conversational model of causal explanation, it is based on experimental data. Although experimental research allows for high internal validity due to strict control of variables, it runs the risk of low external validity through presenting the subject with inference taks that are unrepresentative of those encountered in real life. Accordingly it is important to seek support for the model with data from natural sources, such as newspaper reports. Below, I explore the intimate interplay between the logic of causal explanation and the rules of conversation in <u>New York Times</u> reports on the causes of the <u>Challenger</u> space-shuttle disaster. I show how analysis of how a real-life explanation is built up reveals processes of causal explanation that had not previously been studied in experimental research. I then report a series of experimental studies which investigate what makes a good explanation.

<u>Maxims of causal explanation</u>

With some exceptions (Einhorn and Hogarth, 1986; Leddo, Abelson and Gross, 1984; Read, 1987) researchers on causal explanation have on the whole paid little attention to the fundamental question of what makes a <u>good</u> explanation, in contrast to the effort expended on investigating the internality. stability, globality and controllability of explanations. In this section I develop the argument that a good explanation is one that satisfies Grice's (1975) maxims of conversation.

Grice (1975) proposed that utterances made in normal co-operative conversation should follow four maxims. The <u>maxim of quality</u> states that an utterance should be true, or reasonably likely to be true. The <u>maxim of quantity</u> states that an utterance should be informative. The <u>maxim of relation</u> states that an utterance should be relevant and to the point. Finally the <u>maxim of manner</u> states that the utterance should be clear. Good explanations should satisfy these four maxims (Hilton, 1990).

Moreover the maxims provide constraints that need to be satisfied by any process of explanation generation.

This can be demonstrated with reference to explanations of the Challenger disaster. Suppose a completely uninitiated observer, unaware of the workings of space rocketry or of the history of the Challenger disaster, were to ask why the accident happened and received the answer "Because the spaceship was launched in cold weather". Without further information of various types, the truth, informativeness, relevance and clarity of this explanation remains to be established.

Perhaps the first question to be answered is, how could cold weather possibly be connected to the final explosion? To understand the relevance of the answer to the causal question, the hearer needs to have background information about the rocket's structure (e.g. that rubber O-rings were used to seal the booster rockets) and some knowledge of the relevant physics (e.g that cold weather causes rubber to lose its flexibility, hence hindering the seal's efficiency). Consequently, for a given explanation to satisfy the maxim of relevance, the hearer must have appropriate background knowledge.

Coherent explanations show how a number of relevant facts are combined into single underlying "story" through some hypothesised process. Part of the final explanation of the Challenger disaster runs along the following lines. Cold weather made the rubber O-rings inflexible which impeded the efficiency of the seals, thus leading to a burn-though of one of the lower seals in the left-hand booster rocket. This explains the puff of smoke which emerged by the seal during lift off, and why the final disaster was sparked by an explosion in this area some 70 seconds later. It also explains the complete failure to receive warnings of the disaster due to the absence of sensors in this area of the rocket, other than the loss of power in the left-hand booster 4 seconds before the final catastrophe.

Note that in order to satisfy the maxim of quality, the explanation must not only itself be true but also coherent with background knowledge. Thus it is not enough to know that it was cold on the day of lift-off, we must also be confident that the other, implied parts of the explanation are also true. For example, if we explained the disaster in terms of cold weather on the understanding that the intervening cause was that the lift-off blast blew ice onto the space-shuttle orbiter, whose skin was thus punctured, thus leading to disaster, then we would consider the explanation untrue if we considered the underlying hypothesis to be untrue. In fact, cold weather was cited as a possible cause under a "blasted ice" explanation which was then discarded, only to be resurrected again as a possible cause under the "faulty seal" hypothesis.

Finally, explanations should satisfy the maxim of quantity. If the hearer already knows that the cold weather is part of the explanation, then it would be more informative to cite parts of the explanation that the hearer does not yet know about, e.g. about the flawed performance of the rubber seals in cold weather. Likewise, explanations should avoid unclarity. Thus an explanation should not use a jargonated term such as "O-rings" if the hearer does not know that this refers to the rubber seals.

A model of the process of explanation generation

Hilton, Mathes and Trabasso (in press) outlined a two-stage model of explanation generation that satisfies the above constraints. The first-stage they termed hypothesis-generation and the second they termed explanation-tuning. Hypothesis generation corresponds to the process whereby we diagnose what the cause of an event is, whereas explanation-tuning refers to the process whereby we use our diagnosis to answer some specific why-question (cf. Hilton, 1990a).

In the first stage of hypothesis-generation the aim is to find the causal explanation of the target event which is most probably true. An explanation consists of a number of elements (background facts and problematic aspects of the spaceship's construction and performance) together with a hypothesis about the process which links the problematic aspects together. Background facts include basic information which is necessary to understand a focal set of events. Thus it is necessary to know basic facts about the space-shuttle's construction, such as that it is made of three main components (the booster rockets, the external fuel tank, and the orbiter carrying the astronauts) in order to understand the significance of focal events that make the "story" explaining the accident. Problematic aspects are facts (e.g. weak seals) and events (the observation of a puff of smoke from the seals during lift off from the launch pad)that are focal because they may have played a role in the disaster.

At first a candidate explanation may only be very vaguely specified. It may, for example, have elements (e.g. weak seals) without specifying a process, or hypothesise a process (burn-through) without specifying elements. However, more fully-fledged hypotheses are grown out of a set of these vague "kernel hypotheses" (cf. Abelson and Lalljee, 1988) through processes of elaboration (e.g. adding causal links) and further specification (being more precise about the elements concerned). These hypotheses are evaluated in terms of internal consistency and probable truth, until one remains as the most probable explanation. Here, the best explanation is the explanation is the one that is most likely to be <u>true</u>.

However, good explanations must be more than just true or likely to be true, they must also be felicitous (i.e. informative, relevant and clear). Consequently, explanations may be "tuned" in various ways. For example, the "faulty seals" scenario may be felicitously explained in different ways depending on the hearer's interests and/or knowledge-state. Questions focusing on the role of the design of the shuttle in causing the disaster may felicitously be answered by reference to the faulty seals, whereas questions focusing on the role of the decision to launch may focus on the cold weather. Both explanations are equally likely to be true, coming from the same causal scenario, but are likely to differ in how well they address the implicit focus of a causal question.

The process of specification of explanations offers an interesting trade-off between the maxims of quality and quantity. A vague explanation, such as "something about the booster rocket" is quite likely to be true but too vague to be useful. In fact, the New York Times spent a substantial amount of time in further specifying this explanation in a process described by Mackie (1974) as the "progressive localization of cause" (See Figure 2).

INSERT FIGURE 2 ABOUT HERE

Note that each time the explanation is changed by being made more precise, it is also less likely to be true, since more precise explanations have a greater chance of being falsified. That the explanations are nevertheless changed in this way clearly demonstrates that there is more to a good explanation than simply having high truth value. Thus, in this second stage of "explanation-tuning", the best explanations are those that are more felicitous.

This model of causal explanation has a number of important distinctive features. First, it studies how natural explanations are grown and elaborated, whereas previous work has studied how hypotheses are tested in artificial settings (cf. Bruner, Goodnow and Austin, 1956). Although Abelson and Lalljee (1988) have proposed a similar model, it remains to be empirically tested. The conversational model presupposes the extensive use of knowledge-structures of the kind proposed by Abelson and Lalljee (1988) to build explanations at the hypothesis-generation stage, but emphasises the role of conversational maxims (truth, informativeness, relevance and clarity) to constrain and "tune" the explanations generated. Hilton et al. (in press) outline the kind of content analytic techniques necessary to test such a model. Second, the conversational model distinguishes between different qualities (e.g. truth and felicity conditions) which contribute to the quality of an explanation. I show below how truth and felicity conditions make separate contributions to the quality of an explanation, in a way that has not been recognized by previous models of causal explanation.

Context effects on causal explanation: Probability and relevance

Einhorn and Hogarth (1986) argue persuasively that contextual information can have dramatic effects on the quality of a target explanation. However, the conversational model of causal explanation goes beyond their account in distinguishing different ways in which context affects the quality of a causal explanation. In particular, the distinction between the explanation-generation and explanation-tuning phases of causal explanation enables us to discriminate whether new information affects the quality of a given explanation by reducing its likely truth value (e.g. by suggesting alternative explanations) or by reducing its felicity (e.g. by making it uninformative or irrelevant to cite, even if it is still true).

This can be illustrated through examples used by Einhorn and Hogarth (1986). They give the example of a factory worker who is suing the company he works for causing his lung cancer. The grounds for his suit are that the cancer rate in this particular factory is nine times the rate in comparable industries. However, the factory's lawyers counter this claim by arguing that the factory worker is a heavy smoker, and that his family have a history of lung cancer. Consequently, the effect of the context is to <u>weaken</u> belief in the probable truth of the given explanation by suggesting that a rival hypothesis be generated. Here the rival explanation constitutes outright disagreement over what constitutes the true cause. Consistent with this, Hilton (1989) found that after receiving the contextual information, subjects were more likely to judge working in the factory as less necessary for the worker to get cancer (Expt. 1), and significantly revised their belief that the cancer was caused by working in the factory downward (Expt. 2). They also considered the explanation to be less informative, relevant, true and good (Expt. 3). Thus, the context appears to weaken the quality of target explanation through causing its probability to be discounted (cf. Kelley, 1972), as well as affecting its explanatory relevance, as measured by its perceived informativeness and relevance.

Einhorn and Hogarth (1986) give another persuasive example of how context affects the quality of a target explanation. In this example, a hammer is observed coming down on a watch, which immediately breaks. The best explanation clearly appears to be that the watch broke because the hammer hit it. However, when contextual information is added that this was done as part of a routine testing procedure in a factory, this explanation loses its appeal. Instead, people are more likely to say that the watch broke because of a fault in the glass.

However, close consideration of this example suggests that the context affects the quality of the target explanation for quite different reasons than in the lung cancer example. Rather than suggest a rival hypothesis, the information that the hammer struck the watch as part of a routine testing procedure fleshes out the "hammer strike" explanation. It appears still just as true that the watch broke as a consequence of the hammer hitting it. However, given that the hammer strike is routine, it becomes backgrounded as a normal "mere condition" which is not informative or relevant to cite in a causal explanation. In this context, the fault in the glass becomes the "abnormal condition" (Hart and Honoré, 1985; Hilton and Slugoski, 1986) that makes the difference between this watch breaking and normal watches which do not break. Consistent with this interpretation, Hilton (1989) found that adding the context information in this example did <u>not</u> lead the target explanation to be considered less necessary (Expt. 1), or to significantly revise their belief that the watch broke because the hammer hit it. Although they considered the target explanation to be less informative, relevant and good, they did not change their belief in the truth of the explanation. Thus, the context appears to have affected the quality of the target explanation through affecting its explanatory relevance (perceived informativeness and relevance), but not its probability or truth value.

Clearly, context may affect the quality of an explanation for different reasons. We may wish to change a given explanation either because we feel it to be less likely than the one we prefer, or because we feel it to be less informative and relevant. Recognizing the deep underlying reasons for the change is important. For example, if we believe an explanation for a disaster to be less likely we are less likely to act on it. Thus, if the fuel tank is discounted as the cause of the Challenger disaster we are not likely to want to change its design. However, consider the case where we change our explanation of the Challenger disaster from "the faulty seals" to "the cold weather" to meet the specific contrast implied question as to why Challenger exploded on this launch but not others. Although uninformative and irrelevant with respect to this specific question, the faulty seals still remain a necessary condition for the disaster. Moreover, because we still believe that they are part of the causal scenario leading to the disaster, we may act on this belief and have the seals redesigned so as to avert future disasters.

<u>Pragmatic constraints on the selection of causes from conditions</u>

Leddo, Abelson and Gross (1984) found that goal-states such as "John was hungry" were judged as being more likely to be part of the actual explanation of an event such as stopping in at a restaurant to eat in than script-preconditions such as "John had money in his pocket". Moreover conjunctions of a goal-state and a script-precondition, such as "John was hungry and had money in his pocket" were judged as more likely explanations than script-preconditions such as "John had money in his pocket". Leddo et al. (1984) discuss these effects in terms of the greater <u>plausibility</u> of the preferred explanations. for example, they note that the tendency to rate conjunctive explanations as more likely than single explanations to be part of the actual explanation appears to break the conjunction rule that no conjunction (e.g. A&B) can be more probable than one of its conjuncts (e.g. A; see Tversky and Kahneman, 1983).

The conversational model of causal explanation can quite naturally explain these results. Goal states are preferred as explanations over script-preconditions because they are more likely to be "abnormal conditions" (Hart and Honoré, 1985). Hilton and Knott (1988) obtained results consistent with this position. Goal-states are more likely to be judged as necessary and sufficient conditions than script preconditions, which were more likely to be judged as necessary but not sufficient conditions (Expt. 1). In addition, as would be predicted by the conversational model, goal-states were judged as more informative and relevant than script-preconditions. However, it was reasoned that adding information that a script-precondition held true (e.g. having money in one's pocket) would be perceived as more informative and relevant when it was already known that the relevant goal-state for an action such as eating in a restaurant (e.g. being hungry) held true, since it becomes meaningful and relevant to check preconditions for a goal-state that is known to exist. These predictions were confirmed. When a goal-state was included in the context, script-preconditions were judged as more informative and relevant than when no goal-state was included in the context.

These results are consistent with the predictions of the conversational model that the goodness of an explanation is affected by its explanatory relevance as well as by its likely truth-value. This not to deny, of course, that the quality of an explanation is often affected by its perceived probability (cf. Leddo et al., 1984). However, the unique contribution of the conversational model is to distinguish the role of truth and felicity conditions in contributing to the perceived goodness of an explanation, and thus to enable us to discriminate the role of belief from that of conversational purposes in determining the perceived goodness of an explanation.

The explanatory relevance of causal attributions

Finally, it is worth noting that major theories of the attribution process have in part finessed the problem of explanatory relevance by dealing only with very general, vague explanations. Thus most theories of the attribution process (Hilton and Slugoski, 1986; Jaspars, Hewstone and Fincham, 1983; Jones and Davis, 1965; Kelley, 1967; 1972; 1973) describe how laypeople attribute causality for an event to "something" in the person, the stimulus or the occasion involved in the production of the event, but do not tell us what a good "person", "stimulus" or "occasion" explanation might be (cf. Lalljee and Abelson, 1983). This observation underscores the point that attribution theory has been more concerned with the truth of causal explanations than their relevance.

As Hilton and Knibbs (1988) note, attribution to vague general categories may lead to true but useless explanations. For example, Justin may be interested in establishing why Laura behaved so coolly to him on a date. Justin may know that Laura has behaved this way to him on previous dates (high consistency), and have established that she acts coolly to other people on a date (low distinctiveness), while most girls simply boil over with passion when out with Justin (low consensus). Justin, being scientific in his approach to such questions, arrives at the logical conclusion that it is something about Laura that is causing her to act cool. Still, although very probably true, this attribution may not be very relevant to Justin's problem of how to infuse Laura with passion for him. A more specific explanation indicating whether Laura's coolness is due to her being a wilting flower or a tough cookie would clearly be a more relevant answer to Justin's inquiry, since it would help him further his amorous goals.

In related vein, Hampson, John and Goldberg (1986) point out that there is often a trade-off between making a specific trait attribution and a general one. Do we attribute Mary's successful performance on the violin to her being generally talented or simply musical? The specific trait attribution is more likely to be true, and presupposes the more general one. However, because it generalises over fewer situations, it is less likely to be informative. Thus, if the goal of the attribution process is to be able to predict Mary's future behavior, the general trait attribution will have the most explanatory power but the least chance of being true. Or, to recast this observation in Gricean terms, saying "Mary is talented" on the basis of observing her violin playing, would conform to the maxim of quantity at the risk of violating the maxim of quality.

CONCLUSIONS

Causal explanation appears to proceed through the application of counterfactual reasoning. Recognition of this enables attribution theories to be organised into a badly needed coherent framework (Hilton, 1988; 1990; see also Lipe, in press, for a similar proposal), a task called for by both Kelley and Michela (1980) and Harvey and Weary (1984). It also enables similarities between causal reasoning in attribution tasks and other examples of causal reasoning to be more clearly explicated than before. Thus models of counterfactual reasoning based on

Mackie's (1974) work have been applied in cognitive psychology (Kahneman and Tversky, 1982; 1986), decision theory (Einhorn and Hogarth, 1986) and discourse comprehension (Trabasso and Sperry, 1985; Trabasso and van den Broek, 1985).

Dispositional attribution, on the other hand, appears to proceed through a process analogous to Mill's method of agreement. The functional approach is thus able to reconcile "difference-based" models (Hewstone and Jaspars, 1987; Hilton and Jaspars, 1987; Jaspars, 1983; 1988; Jaspars et al., 1983) and "agreement-based" models (Alicke and Insko, 1984; Bassili and Regan, 1977; Hansen, 1980; McArthur, 1972; 1976; Orvis et al., 1975) within a single framework. Moreover it predicts <u>when</u> a particular method of induction will be used. Thus the method of difference will be used to make causal explanations and the method of agreement to make dispositional attributions.

The conversational model explains how subjective presuppositions are used to "fill out" the missing dimensions in Kelley's (1967) cube (Hilton and Slugoski, 1986). When this is done, subjects' causal inferences are shown to be quite rational (Hilton, 1988; 1990). When the cube is filled with explicit information, subjects use consensus, distinctiveness and consistency information in exactly the way that would be predicted by a rational model of causal induction (Cheng and Novick, 1990; Försterling, 1989). As well as showing that subjects use base-rate information in the form of norms rationally, and do not underuse consensus information, the conversational model suggests that other biases such as actor-observer differences and success/failure asymmetries in explanation may be due to the implicit focus of why questions.

Moreover, the conversational model does more than clarify how causal explanations are made using the information specified in Kelley's (1967) cube. It shows how causal explanations made from ordinary language follow discourse rules. Thus good explanations follow Grice's (1975) logic of conversation. Recognition of this helps understand why less probable explanations are preferred because they are more informative, how context can affect the perceived quality of an explanation, and why some kinds of explanation (e.g. goal-states) are preferred to others (e.g. script-preconditions).

The conversational model of causal explanation thus offers both parsimony and power. It is integrates existing models of causal attribution within a single framework as well as being consistent with general models of discourse processes. In addition, it generates new and fundamental questions about what makes a good explanation, such as what determines the trade-off between the probability and relevance of an explanation. Such questions should generate much more research into the processes of natural explanation.

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CsDCy	Inductive logic model	Template-matching model	Abnormal conditions focus model
LLH	P	P	P
LLL	PxC	PC	PxC
LHH	PxS	PSC	PxS
LHL	PxSxC	C	PxSxC
HHH	S	S	S
HHL	SxC	SC	SxC
HLH	Null	PS	P+S
HLL	C	PSC	C

Key: Cs = Consensus
D = Distinctiveness
Cy = Consistency

H = High
L = Low

P = Person
S = Stimulus
C = Circumstances (Occasion in Hilton and Slugoski, 1986)

x = An interaction effect
+ = Two main effects
(Note: Orvis et al. (1975) did not distinguish between types of attribution)

Table 1 ;A comparison of the predictions made by Jaspars et al.'s (1983) inductive logic model, Orvis et al.'s (1975) template-matching model, and Hilton and Slugoski's (1986) abnormal conditions focus model.

	Locus of explanation	
	Method of difference (Jaspars, etc.)	**Other models** (McArthur, etc)
Consensus ------------------>	Person	Stimulus
Distinctiveness ------------>	Stimulus	Person
Consistency------------------>	Occasion	Occasion

Table 2: Relations between covariation and causal explanation specified by Mill's method of difference and other models

Method of difference

	Factors	Outcome
Target case	Paul + Linda	Help given
Comparison cases	John + Linda	?
	George + Linda	?
	Ringo + Linda	?

Table 3: The logic of the method of difference as applied to person causal explanations

Method of agreement

	Factors	Outcome
Target case	Paul + Linda	Help given
Comparison cases	Paul + Yoko	?
	Paul + Patti	?
	Paul + Barbara	?

Table 4 : The logic of the method of agreement, as applied to person dispositional attributions

Target event: "Ralph trips up over Joan dancing"

Explanation: "Something about Ralph" and "Something about Joan"

	S	$\overline{S}$
P	Target event 1	Distinctiveness 1
$\overline{P}$	Consensus 1	Norm 1/2

Target event: "Sally buys something on her visit to the supermarket"

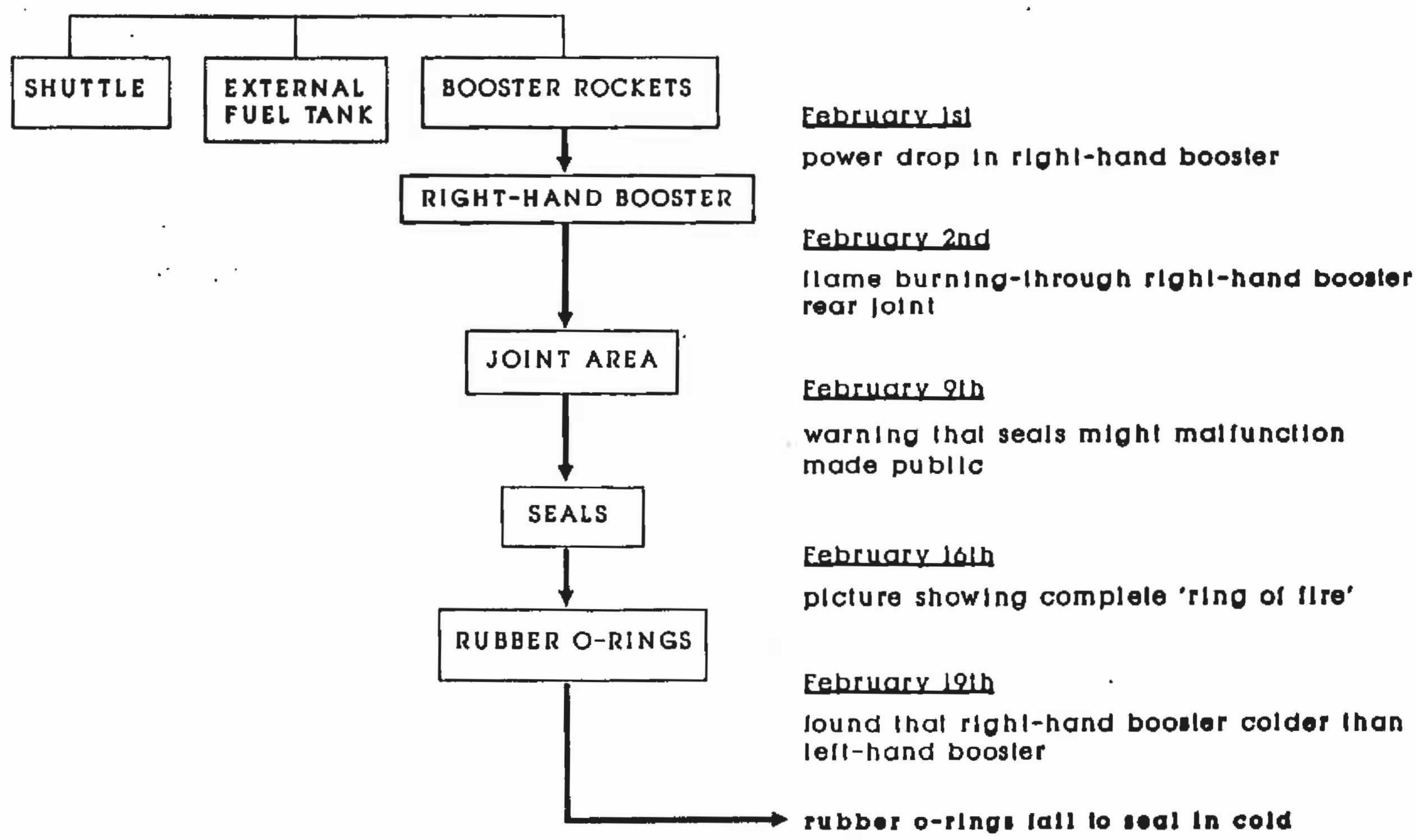
Explanation: "Nothing special about Sally or the supermarket"

	S	$\overline{S}$
P	Target event 1	Distinctiveness 1
$\overline{P}$	Consensus 1	Norm 1

Key : P = Target person present, $\overline{P}$ = Other target persons present
S = Target stimulus present, $\overline{S}$ = Other target stimuli present

Figure 1: 2 X 2 data-matrices for high consensus, low distinctiveness events as a function of presupposed norms

Figure 2: **Hypothesis generation and progressive localization of cause**



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